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(54) IMPROVEMENTS IN OR RELATING TO ELECTRICAL POWER SUPPLY CIRCUITS

(71) SIEMENS AKTIENGESELLSCHAFT, a Germany Company, of Berlin and Munich, German Federal Republic, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The invention relates to electrical power supply circuits providing for the rectification of alternating voltages in either one of two different ranges, using a rectifier circuit having input terminals to which the respective a.c. supply voltage is applied via supply terminals, and output terminals from which the rectified d.c. voltage is obtained.

Bridge rectifier circuits incorporating four rectifiers have been known for a long time, and are frequently employed to produce a required d.c. operating voltage from any a.c. mains supply. Supply circuits of this kind are desirably capable of operating from alternating mains supplies of different voltage ranges, generally mains supply voltages of 110 V, 125 V, 220 V and 240 V being provided for. For that purpose a tolerance range of −15% and +10% is necessary, so that the rectifier circuit has to handle any mains voltage range from a value of about 93 V up to 264 V. Of course, this is quite possible in principle, but requires a high expenditure in switching means and other components.

On closer examination of the mains voltage range mentioned, it becomes apparent that the alternating voltages which need to be taken into consideration are restricted to those values within the ranges from 93 V to 137 V, and from 187 V to 264 V, the intermediate range being unnecessary. The range of adaptability required can therefore be substantially limited, if voltage doubling is effected when used with the lower range of the mains supply voltage, i.e. mainly at 110 V.

Nevertheless, part of the saving may be lost if a known doubler circuit should be required as an additional arrangement, or a complicated switch-over is required to change from conventional bridge circuit operation to voltage doubler operation.

One object of the present invention is to provide a supply circuit which enables a switch-over between two voltage ranges to be effected in the easiest way possible, without additional components.

The invention consists in an electrical power supply circuit in which switch means are provided to permit operation at either one of two different mains supply voltage ranges and supply a d.c. load connected between two output terminals of a bridge rectifier circuit, two capacitors of substantially equal capacitance being connected in series between the output terminals of said bridge retcifier circuit, said bridge retcifier circuit having a first input terminal connected to one mains supply terminal, and the junction between said capacitors being connectible via said switch means to the other mains supply terminal for operation at a low mains supply voltage.

Thus, in a circuit constructed in accordance with the invention, operation of the retcifier bridge can be adjusted by means of a simple switch means in the form of a bridging link or single-pole switch in such a manner that two of the rectifiers act as part of a voltage doubling circuit when it is required to provide for operation at a low mains voltage. The two remaining rectifiers stay blocked with such a method of operation. Usually, the need for two capacitors does not involve additional expenditure for components, since with a normal bridge circuit at least one filter capacitor is required, and in many cases this capacitor is divided into two series-connected capacitors for economical reasons. Voltage doubling can thus take place during low voltage range operation without the necessity to provide

additional components.

In many fields of application it is desirable to connect an additional a.c. device adjacent the d.c. load device, the a.c. device being a small load relative to the d.c. load. Thus, for example, with teleprinter systems a small fan motor is often operated, using a power of only a few watts, whereas the d.c. loading amounts to a few hundred watts. Heretofore, this small fan motor has been provided with its own separate switch-over arrangement to provide for operation at either of the mains supply voltages with a power supply circuit constructed in accordance with the invention, it is now possible to dispense with any physically separate switching arrangement and directly connect a small a.c. device between the junction point of the two capacitors and one of the mains supply terminals. As long as direct current is flowing to a load connected between the output terminals the small a.c. utilisation device continuously receives an a.c. voltage in the low voltage range value (110 V), whether the voltage applied to the mains supply terminals at that time is in the high voltage range (220 V) or in the low voltage range. Thus, no physically separate switch-over means are required for the a.c. device, and this eliminates any danger that during a change of the supply circuit switch means an incomplete switch-over of the equipment may be carried out, by leaving one switch means unoperated.

If the d.c. load can be assumed to be connected at all times, it is sufficient to connect the a.c. load device which is small in magnitude relative to the d.c. load directly between the junction of the capacitors and said one mains supply terminal. However, if there is not a continuous d.c. load at the output, a constant supply to an a.c. device can be achieved by means of a further development of the invention, in which an a.c. device is provided with alternative connections to allow for the application of either of two different operational voltages and these connections may be switched over by the same switch means which determine the operation of the supply circuit, the arrangement being such that the switch means is operable to selectively connect the junction of the capacitors to said other mains supply terminal for operation at a low mains supply voltage, or to connect the second input terminal of the bridge circuit to said other terminal for operation at a high mains supply voltage. The a.c. device, for example a fan motor, may have windings directly connected by their terminals to said one input terminal and said switch means, or may be coupled thereto via a small transformer.

The invention will now be described with reference to the drawings, in which:—

Figure 1 is a circuit diagram of one exemplary embodiment constructed in accordance with the invention; and

Figure 2 is a circuit diagram, having a small a.c. utilisation device which is designed for two voltage ranges.

Figure 1 shows a simple embodiment incorporating a bridge rectifier which consists of four diodes D1, D2, D3 and D4. For connection of a mains supply voltage U_N supply terminals 1 and 2 are provided, which are used for mains supplies of 220 V or 110 V. The direct voltage output is provided between terminals 3 and 4. Two capacitors C1 and C2 are connected in series between these output terminals.

If a mains supply voltage in the range of 220 V is applied between the supply terminals 1 and 2, then the rectifier bridge operates in the normal way, and capacitors C1 and C2 serve to smooth the output voltage. However, if a mains voltage in the range of 110 V is applied between the supply terminals, a switch means in the form of a bridging link or single-pole switch S1 completes a circuit between terminals 5 and 6, when operated so to do, so that the rectifiers D1 and D2 then act together with the capacitors C1 and C2 as a voltage doubler circuit, whilst the diodes D3 and D4 remain non-conductive.

With the circuit shown, it is possible to directly connect into the circuit an a.c. device which represents only a small load relative to the d.c. output, so that it constantly receives the same alternating voltage, whatever the value of the mains supply that is applied. This possibility is represented in Figure 1 by a dotted line joining a motor M between the mains supply terminal 1 and the connection point 6 between the two capacitors C1 and C2. Completely independent of the value of the applied mains voltage, 220 V or 110 V, and whether the switch S1 is accordingly open or closed, the fan motor M constantly receives an alternating voltage of 110 V. provided that a direct current is constantly flowing between the output terminals 3 and 4.

In the event that it cannot be assumed that a d.c. output current is used continuously, a modified circuit for the a.c. load device may be used, as is shown in Figure 2. In this case the motor M is connected, in the exemplary embodiment shown via a transformer having a primary winding L1 which has a tapping 7 and an end connection 8 selectively connectible for two voltage ranges by operation of a single pole change-over switch S2 by which the mains supply terminal 2 can be selectively connected to the input terminal 5 of the bridge circuit for high mains voltage operation or to the connection point 6 between the capacitors C1 and C2 for low mains voltage operatoin, the same switch at the same time serving to join the mains supply terminal 2 either to the tap-

ping point 7 in the case of low voltage supply or to point 8 of the primary winding L1 of the transformer in the case of high voltage supply, so that the motor M always receives the same voltage via a secondary winding L2. The transformer can be omitted if a motor load M having windings designed for two different voltage ranges is employed, which can be selectively connected accordingly, in like manner to the selective connection of the primary winding connections of the transformer in the illustrated embodiment.

Thus. with the arrangement shown in Figure 2, a switchover of the d.c. load device and of a relatively small a.c. load device can take place simultaneously by operation of the single-pole changeover switch. S2. It should be emphasised that when operating with a low mains voltage (110 V), no significant current flows via the retcifier bridge and the transformer winding L1, since the a.c. load device is a small load, which equals about a hundredth part of the direct-current load, and therefore the impedance presented when the circuit is connected for operation at a low mains voltage is such that the voltage doubler circuit is as effective as the circuit shown in Figure 1.

WHAT WE CLAIM IS:—

1. An electrical power supply circuit in which switch means are provided to permit operation at either one of two different mains supply voltage ranges and supply a d.c. load connected between two output terminals of a bridge rectifier circuit, two capacitors of a substantially equal capacitance being connected in series between the output terminals of said bridge rectifier circuit, and the junction between said capacitors being connectible via said switch means to the other mains supply terminal for operation at a low mains supply voltage.

2. A circuit as claimed in Claim 1, in which there is connected between the junction point of the two capacitors and the one mains supply terminal an a.c. load device which is small in magnitude relative to the d.c. load connected between said output terminals, and said switch means being operable to connect the junction between said capacitors to the second input terminal of said bridge circuit for operation at said low mains supply voltage, said second input terminal of said bridge circuit being connected to said other mains supply terminal.

3. A circuit as claimed in Claim 1, in which said switch means is operable to selectively connect the junction of the capacitors to said other mains supply terminal for operation at a low mains supply voltage, or to connect the second input terminal of said bridge circuit to said other mains supply terminal for operation at a high mains supply voltage, there being connected between the second input terminal of said bridge circuit and said one mains supply terminal an a.c. load device which is small in magnitude relative to the d.c. load connected between said output terminals, and said a.c. load device having a tapping connected to the junction of the two capacitors.

4. An electrical power supply circuit substantially as described with reference to Figure 1 or Figure 2.

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1 SHEET *This drawing is a reproduction of the Original on a reduced scale*

Fig.1

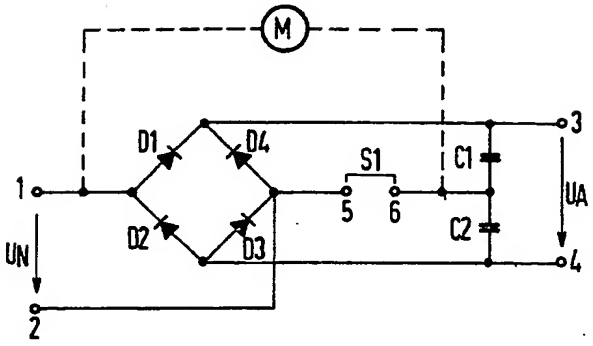

Fig.2